Agricultural Sciences
December 1987

1987 Accomplishments for Research, Extension, and Higher Education

A Report to the Secretary of Agriculture

The Joint Council on Food and Agricultural Sciences was established by Congress in 1977 to encourage and coordinate research, extension, and higher education activities in the food and agricultural sciences throughout the United States. This role was strengthened in the 1981 Agriculture and Food Act, which directed the Department to improve the planning and coordination of research, extension, and higher education within both the public and private sectors and to relate the Federal budgeting process to the overall functioning of the system. The Joint Council's responsibilities were reaffirmed in the Food Security Act of 1985.

In 1984 the Joint Council published a long-term (20 years) **Needs Assessment** of the food, fiber, and forestry products sectors, with particular emphasis on the supporting role of the food and agricultural science and education system. This report was published in two volumes: *Reference Document: Needs Assessment for the Food and Agricultural Sciences;* and *Summary: Needs Assessment for the Food and Agricultural Sciences.* The congressionally mandated responsibilities and the material in these two documents provide the foundation for the Joint Council's activities.

The Joint Council prepares three other reports to meet its coordination and planning responsibilities. A **Five-Year Plan** reflects the issues and challenges that the food, fiber, and agricultural production system will face during the next 5 years and the goals and objectives necessary to adequately address them. The **Five-Year Plan**, initially published in 1984, is updated biennially. It provides overall guidance and direction to the food and agricultural science and education system within the U.S. Department of Agriculture and its cooperating institutions.

The Council's **Priorities Report** outlines the current national emphases of research, extension, and higher education programs in the food and agricultural sciences. This annual report presents ranked national priorities for the next fiscal year.

The annual **Accomplishments Report** provides examples of both long-term and current accomplishments of the research, extension, and higher education programs, including interagency and interdisciplinary activities.

These three reports constitute an overall strategic planning and review process. This process facilitates and enhances the coordination, planning, and financial relationships through which short-term and longer term future needs are defined, goals and objectives are established, and accomplishments are noted. The reports provide the foundation for planning an efficient and effective means for meeting the future national and international demands for food, fiber, and forest products.

The Joint Council symbol represents the Council's primary responsibility: to improve coordination and planning among research, extension, and higher education programs. It also characterizes the cooperative spirit that exists among the Federal, State, and private organizations and institutions within the food and agricultural science system.

Joint Council on Food and Agricultural Sciences

Secretariat:
Rm. 1410, South Building
U.S. Department of Agriculture
Washington, D.C. 20250-2200

November 30, 1987

Honorable Richard E. Lyng
Secretary of Agriculture
Washington, DC 20250

Dear Mr. Secretary:

On behalf of the Joint Council on Food and Agricultural Sciences, we are pleased to share the 1987 Accomplishments Report with you. As you know, Section 1407, Public Law 95-113, as amended by Public Law 97-98, requires the Council to provide you with an annual summary of the progress that the food and agricultural sciences research, extension, and higher education programs have made.

A new feature of this year's report is the section describing eight longer term accomplishments which represent activities that come to fruition only after a number of years of effort. The section on current accomplishments represents the more than 230 examples submitted to the Joint Council by the National Committees on Research, Extension, and Higher Education. Summaries of the activities of the Joint Council Secretariat, the three National Committees, and the Regional Councils are also included.

If you wish to discuss the report, we would be happy to do so.

Sincerely,

Orville G. Bentley
Cochair

Charles E. Hess
Cochair

Enclosure

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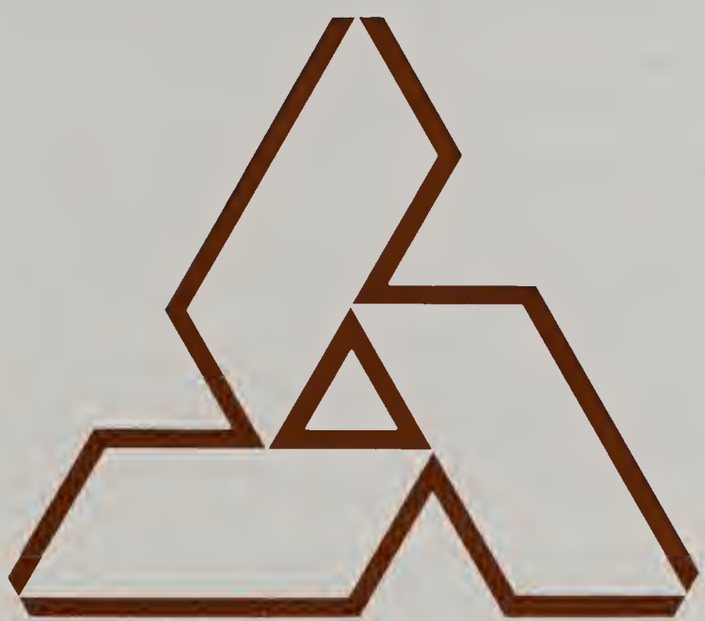
Secretary of Agriculture



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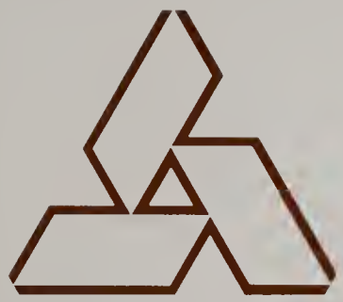

Introduction

"...man began with speech, civilization with agriculture." *

The United States is celebrating the bicentennial of its Constitution, which ranks as one of civilization's longer enduring accomplishments. When the Constitution was framed and ratified, about 90 percent of the population lived and worked on farms; since most of them owned their land, the source of wealth was widely distributed. As a consequence, the people had not only social and political reasons for becoming involved in governing themselves, but also economic reasons. The Constitution reflects the values of that agrarian society: high regard for individual freedoms and a great appreciation for agriculture as the foundation of society and the economy.

For the 100 years after the ratification of the Constitution, the population remained mostly agricultural and rural. The importance of agriculture to the young republic permeated its political, social, and economic fabric. In 1862, the U.S. Department of Agriculture was established and Congress passed the Morrill Act, which created the land-grant university system. In 1887—100 years ago—the Hatch Act established an agricultural experiment station in each State.

Twenty-seven years later, the Smith-Lever act of 1914 established the Cooperative Extension Service in each State to enhance and facilitate the transfer and application of knowledge generated by the experiment stations and others. Relatively recently, higher education matters relating to food and agricultural sciences were embodied in the U.S. Department of Agriculture.

The contributions of this ever-evolving system of knowledge generation and application explains, in large part, the continuing improvement in the quantity, quality, and wholesomeness of U.S. agricultural products.

Although U.S. agricultural productive capacity is often called a modern miracle, it is actually the result of decades of substantial public and private investments in people, facilities, research, extension, and higher education. In many instances, these investments come to fruition only after a number of years of incremental accomplishments. As these incremental additions to the information base are combined over time, they permit the formulation of solutions to many large, complex physical and scientific problems.

Through such a merging of individual accomplishments, for example, have come the tools that today, in combination, are known as biotechnology. Biotechnology began with the basic genetic and microbiological research conducted in the 1940's and early 1950's. With each passing year, scientists gained more pieces of information that could be put together into larger pools of knowledge about such key topics as basic genetics and the workings of DNA. Today, the level of knowledge permits scientists to modify plants and animals in ways that enable them to withstand, among other things, varying degrees of stress resulting from climate, pests, fungi, etc., thus enhancing production efficiency, reducing risks, and increasing profitability.

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*Will Durant and Ariel Durant, *The Story of Civilization.*

Another ever-expanding knowledge base is in the area of integrated pest management. Continuing interdisciplinary efforts have led—step by step—to the development of a body of knowledge that enables pest control to be accomplished in many cases with minimal adverse impacts on society and the environment.

This 1987 Accomplishments Report provides a summary of the most significant achievements generated by the food and agricultural sciences system during the past year. The 27 shorter term accomplishments are only a sampling of the more than 230 that were submitted to the Joint Council for consideration.

The accomplishments of the past year reveal some important trends:

- Research programs—increasingly funded by competitive grants—have emphasized **fundamental research** in biology, particularly with regard to plants, animals, insects, and microorganisms, and their interaction with the agricultural ecosystem. These fundamental studies are linked to developing an understanding of practical research problems in an effort to improve the efficiency and utilization of the Nation's natural resources, expand scientific expertise, and help ensure economically sound investments in the food and fiber system.

- Extension education and technology transfer have placed increased emphasis on **targeting programs** to resolve high-priority needs. Additionally, Extension has implemented a set of national initiatives designed to address current critical problems facing agricultural, forest-based, and rural communities.

- Higher education programs are emphasizing the need to attract high-caliber undergraduate and graduate students to agricultural fields of study. It is through the development of top-notch agricultural scientists that the research and extension programs are carried out.

As changes in the food and fiber system take place, there are opportunities for linkages with the private sector leading to cooperative programs designed to address broad, multi-faceted concerns to provide relevant and timely information to a broader audience—for example, those involved with low-input agriculture, marketing and utilization of new and alternative products, and the adoption of new technology. To accomplish some of these changes, program administrators are reallocating resources from areas of lower priority to areas where the needs are more pressing.

In addition to the current year's activities, the report presents eight accomplishments that have resulted from long-term investments in research, extension, and higher education. This section of the report illustrates how a variety of resources can be coordinated to provide solutions to agricultural and forestry problems and to problems of people and society.

Each of the eight long-term accomplishments represents a series of incremental achievements which, over a period of years, have combined to yield a significant impact on food and agriculture. They involve a wide array of scientific disciplines and, in some cases, interdisciplinary cooperation. Some have a direct impact on a specific area of agriculture, such as aquaculture; others, such as germplasm management, are more indirect but are of vital national and international importance.

Use of Computers to Deliver Information*

Computer technology has advanced through several generations in the past 10 years. What was possible only on mainframe computers is now handled routinely by inexpensive desktop microcomputers. These advances have fueled revolutionary accomplishments in all aspects of research, teaching, and extension.

*Material for this section was prepared by Fred L. Poston, Washington State University; S. Welch and G. Brandsberg, Kansas State University; Lucas Calpouzos, Chico State University; Steve Rawlins, ARS-USDA, Beltsville, MD.

Mathematical Models: Scientists' use of computers to develop mathematical models simulating complex economic, physical, and biological processes has become firmly established. As a result, high-priority research can be more readily identified. The models permit scientists to identify specific knowledge gaps that can be filled only through new investigations.

As the advent of increasingly powerful desktop computers permits more on-farm applications of these models, research is shifting from a process dominated by "technology push" to one characterized by "market pull." Many models can enhance managerial decisionmaking by predicting the gradual development of crops or animals in response to environmental and managerial activities. For example:

- The GOSSYM-COMAX system, designed for cotton production management, incorporates a scientifically sound crop simulator with a computerized expert system that greatly simplifies its use. This combination is linked with electronic sensors which directly measure environmental conditions. The system is being pilot tested on more than 60 farms throughout the cotton-growing region as a prototype for a farm production decision support system.

- The ProtAG series (formerly ProSeries), developed by Kansas State University Experiment Station and Extension personnel, includes commodity management programs for several crop and animal enterprises. ProtAG has been licensed for use and further development in 16 other States. The value of such systems is exemplified by the many institutions and agencies that support ProtAG—the W.K. Kellogg Foundation, the USDA Extension Service, the National Cattlemen's Association, and the Kansas Soybean Commission.

Access to Data and Communication Systems: As computer development accelerates, users will be able to tap more sources of computerized information. Through laser optical disc technology, for example, microcomputer users can access hundreds of thousands of frames of text, still images, or full-motion video. The National Agricultural Library (NAL), in cooperation with land-grant university libraries and other public and private organizations, plays an important role in this field. Several of the projects are noteworthy:

- The Pork Producers Council cooperated with the Indiana Extension Service in 1984 to evaluate the potential of microcomputers with videodiscs to disseminate full-text databases. The Pork Industry Handbook and 200,000 records from the AGRICOLA bibliographic database were placed on videodisc. A second phase involving 15 institutions (mostly land-grant university libraries) will place 12 other USDA and State Cooperative Extension Service publications on a second disc.

- Several State Extension Services have developed computerized communication systems to help deliver management information and to facilitate internal operations. The Kansas Sunflower Dispatch is an example of a system that provides such services as electronic mail, database and software transfers, bulletin board services, and computer conferencing.

When made broadly available, computerized communication networks can have significant educational advantages. University, community college, and high school agriculture teachers have an instant up-to-date information source for relevant materials. Career opportunities also can be monitored. All groups with access to the network can communicate with each other on topics of interest.

Designers realized that programs should operate similarly across a collection of computer software packages. Consequently, in many second-generation systems, such as the Indiana FACTS system, the mechanics of program operation have been standardized to facilitate user training. The third generation of software integrates a wide range of multidisciplinary information into comprehensive sets providing decision support at all points in the agricultural production process.

Such systems can be heavily oriented towards text retrieval, like the Florida FAIRS system, or they can incorporate both text and software modules into one document. These modules may involve complete simulation models or expert systems, or they may automate very simple "rules of thumb." All modules interact so they can share information fluidly without burdening the user. In this way, many problem-solving methods and points of view can be brought to bear on a given decision.

In 1987, more than 50 land-grant and other agriculture-related university libraries agreed to participate in a pilot project to establish and evaluate a text digitizing image system for preserving agricultural library materials in machine-readable form. Although its feasibility is still being examined, this process could provide access to masses of otherwise unavailable material. The NAL is heavily involved in the pilot project, as is the University of Vermont.

Public Access to Information: As laser optical disc materials become more prevalent, the focus will shift to delivering them to the public. Consequently, it is reasonable to expect that optical disc readers (CD-ROMS) will be found not only in county Extension offices but in other places as well. For example, Virginia's Public Information System project, funded by the Kellogg Foundation, places microcomputers and CD-ROM players in urban shopping centers so people can obtain answers to a vast range of consumer-oriented questions.

Clearly, the impact of computer-based information delivery has been significant over the last 10 years. Even so, the integration of electronic information technology and management is still in its infancy. Continuing advancements are necessary to assist the United States in maintaining its world leadership in food and agricultural sciences.

Education on Nutrition, Diet, and Health*

Researchers have made significant progress over the past 10 years in clarifying the relationships between dietary practices and chronic health problems such as obesity, coronary artery disease, cancer, and hypertension, plus other conditions often associated with overweight and alcohol abuse. Although the evidence is not yet complete, research to date has enabled experts to reach some consensus on appropriate dietary advice for American consumers.

Dietary Information and Changes in Products Available: The dietary guidelines issued jointly by the U.S. Department of Agriculture and the U.S. Department of Health and Human Services suggest dietary practices designed to promote health and fitness: eating a variety of foods; maintaining ideal weight; avoiding too much fat, saturated fat, and cholesterol; eating foods with adequate starch and fiber; avoiding too much sugar and sodium; and consuming alcohol in moderation. While not providing quantitative targets, these guidelines provide useful, research-based information that enables consumers to make informed dietary decisions.

The dietary guidelines are an important part of the public education programs of the USDA Food and Nutrition Information Service, the Cooperative Extension Service, and many other Government agencies. They also have significant impacts on research agendas, particularly in stimulating research on producing food animals with lower fat content while maintaining palatability.

*Material for this section was prepared by Malden C. Nesheim, Cornell University; and H. Russell Cross, Texas A&M University.

Researchers are exploring a number of very promising areas. One deals with swine growth somatotropin and other regulators which have resulted in increases in production efficiency and increases in the lean meat component of the carcass while reducing fat content. Another is identifying repartitioning agents (Beta agonists) that effectively decrease lipid synthesis and protein degradation in sheep, cattle, and swine by increasing use of fat for immediate energy use. A third area is feeding, management, and marketing practices designed to yield animal products that reflect consumer preferences for reduced fat levels.

Such changes in production practices in response to consumer demand and nutritional recommendations show how closely production agriculture is connected to research and education in human nutrition.

Mineral and Nutrient Availability: The past decade also has been a period of exciting research in mineral nutrition, to which USDA Agricultural Research Service (ARS) and State Agricultural Experiment Stations have made major contributions. Research findings concerning zinc, copper, selenium, iron, and calcium have provided information necessary for assessing human requirements for these elements, assessing potential populations at risk of deficiency, and understanding the basic role of these elements in nutrition and metabolism.

ARS and State Agricultural Experiment Stations have given high priority to research on nutrient availability. Utilization of some mineral elements by the body has been shown to depend on the chemical form of the element and on enhancement or interference by other dietary components. This research has considerable significance in examining questions of food fortification, the enrichment of manufactured foods, and the production of infant formulas.

Interest in calcium has been high because of its suspected connection to osteoporosis, a disease primarily of post-menopausal women who suffer from loss of bone mineralization resulting in increased susceptibility to fractures. Researchers are examining the effects of increased calcium intake on the progress of the disease and the relationship of calcium supplementation to exercise and hormone replacement therapies.

Interest in research dealing with food consumption also has expanded. The substantial interest in health effects of consumption of dietary fiber, for example, has led to extensive research on the complex carbohydrate components of foods. Research in the past 10 years has resulted in a better definition of dietary fiber, an understanding of the physiological and health effects of consuming various types of dietary fiber, and the development of composition tables with modern fiber composition values.

Development of simple, accurate methods to determine the components of foods that provide dietary fiber has received considerable attention. It is clear from this research that complex carbohydrates in foods are very diverse and that the physiological effects of fiber consumption vary with the chemical nature of

the fiber components present in food. This has represented a challenge to develop food consumption data that are helpful for assessing diets and providing dietary advice to the public. Food composition values for mineral elements have also been greatly expanded and an understanding of variations in mineral content observed in foods has been an important result.

Consumers are showing great interest in accurate, relevant information about nutrition, health, and fitness. They receive a remarkable array of information on these topics from advertisers, the food industry, television, radio, popular magazines and newspapers, and from a variety of local and Federal governmental agencies. Extension, with its links to researchers at land-grant universities, and USDA's Food and Nutrition Information Service are sources for accurate research-based consumer information on nutrition, diet, and health relationships.

The Extension Service reaches people nationwide with nutrition education for the general public and for a number of groups including pregnant women, infants, children, adolescents, the elderly, and the low-income. Extension nutritionists use instructional presentations, mass media, and other delivery methods so that consumers can become better prepared to sort out reliable information from misinformation.

Extension's "Food and Fitness" program increases public awareness of the abundance and variety of foods provided by American agriculture. The Expanded Food and Nutrition Education Program helps low-income families acquire knowledge and skills necessary for nutritionally sound diets. These programs have permitted the food industry to mount sound educational programs through label information and point-of-sale materials.

Easing Financial Stress*

*Material for this section was prepared by Mike Boehlje, University of Minnesota; Tom Brown, University of Missouri; and Don West, Extension Service-USDA, Washington, DC.

In the 1970's, strong demand for U.S. agricultural products provided incentives for producers to increase the substitution of capital for physical labor and to use more purchased inputs in order to increase production. Many agribusinesses that processed and marketed farm products and provided farmers with supplies expanded their operations as well. The expansion of these businesses necessitated the securing of large amounts of credit, using future production and the associated valuation of agricultural land as the basis for required collateral.

The 1980's, however, brought dramatic changes. Demand for U.S.-grown agricultural products was blunted by declines in worldwide economic growth and large increases in worldwide production of agricultural commodities, particularly those which U.S. farmers sold primarily in export markets. The resulting decline in prices had two impacts:

- The export-market-oriented producers had less income and thus were less able to cope with their debts.

- The value of farm and agribusiness assets fell, reducing their usefulness as collateral and resulting in increased foreclosures.

Resolution of these problems required adoption of sound—and often painful—financial management practices. The need intensified for education to help agricultural producers, lenders, and agribusinesses analyze and deal with their debt problems. The agricultural science and education community responded by identifying relevant financial management concepts and delivering educational assistance.

Financial Management Education: Three major themes, which evolved as a result of collaborative efforts among scientists, Extension, and the lending community, have formed the basis for much of the educational assistance:

- Integrating finance as part of the farm and agribusiness management process.

- Recognizing the critical importance of investment analysis in capital expenditure decisions.

- Using credit wisely.

The development and delivery of this information has occurred in a variety of ways. Changes in trends and the magnitude of emerging problems were identified through analysis of data series maintained by the USDA's Economic Research Service and other research organizations. Economic principles related to the three major themes were brought to bear in the research arena. The results of that undertaking provided the basic financial information shared with producers and agribusiness entrepreneurs, and became the stepping stone for further, more advanced, analysis.

The Extension System became centrally involved in directly helping producers, their families, and agribusiness people deal with their financial crises. Through

substantial redirection of programs, some State Cooperative Extension Services devoted up to 35 percent of their resources to this effort at the height of the crisis.

Farmers are receiving intensive assistance as they develop and improve financial records and use them to analyze their financial situations. Computer programs, such as FINPACK, play an important role in helping producers understand the whole-farm consequences of alternative production, marketing, and financial strategies. Computer programs also are used to assess both the immediate and longer term financial viability of farms and businesses. The Extension community has shared analytical techniques with lenders and agribusinesses. In selected instances, Extension personnel have served as mediators and facilitators between lending institutions and producers.

Evaluating Alternatives: The longer term approach is to help producers evaluate alternatives both on and off the farm, determine financial viability, and make decisions that are consistent with their goals. Such recognition of problems and consideration of alternatives helps to reduce farm family stress. Hotlines are also effective in building information networks and providing necessary emotional support.

At the farm level, evaluation of alternative investments and their impact on profitability and cash flow is being promoted as part of the planning process. Through a systems approach, market analysis is being incorporated with production and financial planning. Producers are learning to analyze capital investment alternatives involving the purchase of land, machinery, buildings, and equipment. With the help of computer technology and Extension education, producers are better able to assess such factors as the effect of debt/equity ratios on rates of return, the ability to carry risk, and the tax implications of various alternatives.

The educational effort has helped agricultural producers understand the role of debt in their operation. Educational programs for farmers and lenders—plus practical assistance in making cash flow analyses, improving financial records, and upgrading performance documentation systems—have helped many operators and agribusiness managers make sound and appropriate use of debt.

The agricultural science and education community was able to respond quickly and effectively to the crisis because of past investment in the skill and capabilities of its people. As a result, thousands of families whose farms were at risk have been able to develop and evaluate alternatives and construct and implement financial "get-well" plans. These financial plans provide the banking community with a basis for reconsidering foreclosure. As a consequence, many families and businesses who might have left farming or farm-related enterprises have been able to remain.

Conservation Tillage Adoption*

The past decade has seen rapid progress in both the technological development and adoption of "conservation tillage"—a term that includes a variety of tillage systems in which crop residues remain at or near the soil surface to reduce soil erosion and water loss. No-till, ridge-till, strip-till, mulch-till, and reduced-till are all conservation tillage practices.

Conservation tillage has emerged as one of the most cost-effective broad-scale approaches for reducing soil erosion and is being adopted faster than any other farming technique in history. The momentum remains strong today. Some form of conservation tillage is now being applied to one-third of the cropland in the United States. The USDA predicts up to 80 percent adoption of conservation tillage practices within 25 years. Managing cropland in this way is the result of well-directed cooperative efforts by research, extension, industry, conservationists, and farmers to solve the serious problem of defining and applying economically sound solutions to soil erosion problems.

Economic Impacts: Economic considerations have been a major force in the shift toward adoption of conservation tillage, since it lowers production costs by reducing fuel and equipment requirements. Labor and fuel costs are reduced by 30 to 90 percent in certain row crop and forage systems. The higher energy costs which began in the 1970's, as well as recent higher interest costs, have served to encourage adoption of conservation practices.

Conservation tillage has made possible several major improvements in agricultural production efficiency. Examples include double cropping, increased

*Material for this section was prepared by Robert I. Papendick, Washington State University; and Peter Bloome, University of Illinois.

annual cropping in traditional wheat-fallow areas, and production of winter wheat in northern areas. Many studies have shown that conservation tillage reduces water and wind erosion by 50 to 90 percent compared with conventional tillage.

Used with complementary conservation measures, conservation tillage can be tailored to control erosion within tolerable levels over a wide range of climatic, soil, and cropping conditions.

Water Quality Considerations: In recent years, the Joint Council has consistently identified water quality as one of the highest priorities facing the research, extension, and higher education entities within the food and agricultural science system. Conservation tillage not only assists in decreasing erosion and runoff, it has significant positive impacts upon improving surface water quality.

Further research is needed, however, to determine the impacts of conservation tillage on ground water quality. Although there is evidence that conservation tillage may have a negative effect, some recent studies have shown that it does not necessarily increase concentrations of nitrates and soluble pesticides in ground water. Many scientists at ARS locations and at State Agricultural Experiment Stations are aggressively researching this important question.

Conservation Tillage Practices: These researchers are providing the flow of basic knowledge essential for the development of conservation tillage systems and have achieved major scientific advances in tillage and planting equipment, pesticide development, and fertilizer management. New knowledge has been gained about the soil environment, crop responses, pest control, and economics of soil-conserving production systems.

Because of the development of planters capable of placing seed in hard soil through heavy residues and the development of techniques for precise fertilizer placement, no-till small grain yields have increased so much that they are now equal to or greater than those produced under conventional tillage. Other advances include the development of the in-row chisel and refinement of slot-mulch tillage systems (crop residues placed in a narrow slot in the soil) for residue management and runoff control.

Ridge-till (planting row crops on a preformed ridge) and no-till (planting in a narrow row) are unique planting systems which leave residues between rows of crops in order to decrease erosion and conserve water while reducing fuel use and equipment costs. Faster seedbed warmup is another important feature of ridge-till in colder areas where corn and soybeans are produced.

Paired-row planting is a new concept in seed and fertilizer placement for no-till. The use of legume cover crops with conservation tillage systems greatly reduces wind and water erosion while providing nitrogen for the following crop. Ecofallow, which employs herbicides to replace all or part of the tillage operations used for weed control, is now well-established as a dryland conservation technique.

New chemicals and biocontrols have opened additional opportunities for crop protection with conservation tillage. Grass weeds can now be controlled in cotton, soybeans, and forage legumes, reducing the need for cultivation. Rope-wick applicators and more effective spraying systems have allowed herbicides to replace tillage in many cases.

Much agricultural research has been directed to conservation tillage goals. For example, researchers have studied pythium root rot and take-all, two serious diseases of wheat that are enhanced by surface-residue farming. Crop rotations coupled with new biological techniques involving coating seeds with protective bacteria can now control these diseases.

Conservation Tillage Education: The Cooperative Extension System and the USDA Soil Conservation Service have been the leaders in technology transfer and education to develop the required management skills for conservation tillage. Industry has developed equipment and chemicals technology for field application. Farmers have been the main knowledge integrators and the source of many innovative ideas that have made conservation tillage work.

A model example of an integrated research and extension effort which has produced much conservation tillage technology for highly erodible lands is the regional-State-USDA STEEP (Solutions to Environmental and Economic Problems) program in the Pacific Northwest. Similar efforts have been initiated recently in the Corn Belt, Southeast, and Great Plains regions of the United States.

USDA and State agencies have developed cooperative educational programs for encouraging widespread use of conservation tillage. The fact that several national conferences on conservation tillage have been held attests to the depth and scope of national interest in the subject. National Extension workshops have increased the emphasis and strength of Extension programs in soil conservation. Regional and local conservation tillage workshops have become major annual educational activities.

The Conservation Technology Information Center has been highly effective as a national focal point for monitoring progress and for exchanging information on conservation tillage. The Center is sponsored by the National Association of Conservation Districts in cooperation with industry, Federal agencies, universities, and farmers.

Adoption of conservation tillage is expected to continue at a rapid rate. Surveys indicate that many farmers are anxious to adopt conservation tillage practices but are restrained by lack of knowledge about pest control, equipment, and economics for their local conditions. Future development will give more emphasis to integrating knowledge, applying biotechnology, and tailoring inputs to reduce operating costs and increase farm profits. Economic incentives will continue to be the main driving force behind the movement to adopt conservation tillage.

Pesticide Education/Integrated Pest Management*

*Material for this section was prepared by David C. McNeal, Jr., Extension Service, USDA; Ray Frisbie, Texas A&M University; Charles Smith, Agricultural Research Service, USDA; and James Parochetti, Cooperative State Research Service, USDA.

The highly successful pest control programs which have been developed during recent years are both effective and consistent with improved environmental quality. These programs have involved many fields of study and have influenced all aspects of pest management systems nationwide. Pesticide education/integrated pest management comprises three specific program areas:

- The Integrated Pest Management program enables pest managers to determine whether pesticide use is necessary in a given situation or if alternative controls will suffice. Integrated Pest Management involves using all suitable and compatible techniques to reduce pest populations and using pesticides in an integrated and environmentally sound manner only when needed.

- The National Agricultural Pesticide Impact Assessment Program ensures that regulatory decisionmakers have objective and accurate information on benefits and risks of selected agricultural and forestry pesticides.

- The Pesticide Applicator Training (PAT) program enables pesticide applicators to use pesticides safely and effectively.

The activities and thrusts of these program areas have significantly influenced production agriculture and the way in which pesticides are used.

Integrated Pest Management (IPM): IPM research programs have synchronized the management of pests with the production of crops to maximize economic yield, increase grower profits, and sustain agricultural productivity. Additionally, the provision of IPM services and information by private agricultural consultants is a multimillion-dollar business contributing to agricultural profitability and environmental improvement.

The application of IPM principles to pest control programs both at the individual field level and at regional levels is possible only because of the cooperation of Federal, State, and local entities in research, extension, education, and regulatory programs, as well as the cooperation of the private sector. Focusing applied research activity on crops with historically high pesticide use patterns or intrinsic factors amenable to implementation of IPM brought early successes to the attention of the agricultural industry and public.

Early Extension efforts in IPM explored sociological factors related to adoption of IPM programs on farms and in communities. The development of local organizations dedicated to IPM implementation provided a framework for the expansion of IPM technologies, philosophies, and practices. Because it can address both profitability and environmental issues, IPM has maintained high visibility throughout most of its recognized existence.

Examination of IPM for applicability in belt-wide application by Economic Research Service, Agricultural Research Service, Animal and Plant Health Inspection Service, and the cotton industry led to development and implementation of an ambitious and successful plan for wide area boll weevil suppression in North and South Carolina.

The formation of a national IPM coordinating committee, with membership from four USDA agencies and the land-grant universities, led to the successful implementation of a system of regional IPM research projects to meet regional needs. The Extension IPM Task Force, which reports to the Extension Committee on Organization and Policy's (ECOP) Subcommittee on Agriculture and Natural Resources, has been instrumental in helping guide the development and implementation of IPM programs in Extension. The experience gained in applying the systems approach to agricultural pest control through IPM will be a major building block in implementing research and educational programs which integrate marketing, management, and production functions for effectively addressing American agriculture's future.

National Agricultural Pesticide Impact Assessment Program (NAPIAP): NAPIAP is a coordinated activity involving seven agencies or offices within USDA (APHIS, ERS, FS, OGC, CSRS, ARS, ES) and cooperating State Experiment Stations, Extension Services, and Departments of Agriculture. Assessment teams assemble existing information to meet the needs of decisionmakers, and NAPIAP coordinates laboratory experiments, field trials, and other studies to generate additional information on efficacy, crop yields, and crop quality.

NAPIAP evaluations for more than 30 pesticides have provided comprehensive and scientifically valid information on the value of pesticides to agricultural productivity and on the effects of pesticide use and regulation on the quality of soil and water resources. The potential adverse economic impact of cancellation of the pesticides which have been the focus of these assessments is billions of dollars annually. Without the information provided by NAPIAP, the Environmental Protection Agency would likely have approved cancellation of several of these pesticides.

Pesticide Applicator Training (PAT): PAT programs have provided specialized training on the safe use and handling of pesticides to almost five million private and commercial pesticide applicators since the program began in 1976. A direct result has been the certification of over 1.5 million pesticide applicators, allowing them to use restricted-use pesticides. Without this certification process, many restricted-use pesticides would not have been available. As a result, crop losses and pest control costs would have been higher, resulting in an encroachment on profitability. Other benefits of the Pesticide Applicator Training programs include improved personal safety practices; environmental protection; reduced pesticide drift; proper transportation, storage, calibration, and disposal; and better pest identification.

New technology and knowledge of pesticide behavior are continually being incorporated into the PAT program. New and emerging issues are identified by USDA, EPA, and ECOP. To meet educational needs and societal concerns, information is also sought from other governmental agencies as well as industry and environmental groups.

The State lead agencies responsible for certification and enforcement of pesticide regulations, industry groups, trade associations, and educational groups have stepped up their educational efforts in pesticide safety to complement and supplement State Cooperative Extension Services' efforts. Major issues which will involve the PAT program are potential effects of pesticides on endangered species and the relationship between pesticides and ground water quality. Implementation of sound educational programs to address these issues will require input from additional public and private sources.

Aquaculture*

The aquaculture industry in the United States has expanded rapidly to become an important alternative agricultural opportunity. The current farm value of annual production from aquaculture enterprises is estimated at half a billion dollars.

*Material for this section was prepared by Meryl Broussard, Extension Service-USDA; and R. Oneal Smitherman, Auburn University.

Aquaculture Development: Recent expansion has occurred in the catfish and crawfish industries. Nearly 300 million pounds of farm-raised catfish are produced annually. This represents a six-fold increase during the past 10 years. The number of acres devoted to crawfish farming has tripled during the same period, and now stands at 150,000 acres. The culture of trout, salmon, bait fish, oysters, and clams has contributed significantly to total U.S. aquaculture production.

Per capita consumption of fish and fish products in the United States is at an all-time high, and the demand continues to expand. Concurrently, yields of ocean fish and fish products have reached a near-maximum sustainable level. Domestic aquaculture production offers a means to meet the nutritional needs of consumers while reducing U. S. dependence on imported fish and fish products. Aquaculture and its allied support industries have resulted in new employment opportunities and have contributed significantly to the rural economies of many States. Aquaculture production can be adopted by small-scale farmers and can also provide recreational opportunities.

Aquaculture Education and Research: Aquacultural research and extension programs at land-grant universities are closely linked and have played a major role in the expansion of the industry. Problem-solving and basic research programs have contributed significantly to the research base. Extension personnel have used the research base to provide information for both county and State extension educational programs. Industry continues to work closely with research and extension institutions, resulting in major innovations that have contributed to aquaculture development. During the past decade, significant advances have been made in intensification of production systems, reduction of losses, aquacultural economics, processing, product development, and marketing.

Improved management strategies have resulted in intensified aquacultural systems and a two- to three-fold increase in production per acre. Aeration, water circulation, and system design research have led to higher production densities. Nutrition research has resulted in more cost-effective feeds and improved feeding strategies. Genetic research has led to improved stocks more adaptable to domestication and intensive culture. Stocking and harvesting strategies have been refined and have allowed for more efficient production and less seasonal harvesting.

These improvements in production strategies have served as a basis for a variety of extension educational programs aimed at increasing profitability for new and existing aquacultural producers.

As production systems intensify, disease losses increase and culture system environments deteriorate. Research has resulted in substantial gains in the prevention, diagnosis, and treatment of aquatic animal health problems. Several States have established diagnostic laboratories which have contributed

significantly to disease control and reduced losses. One State diagnosed more than 2,600 disease cases in a year and reduced losses by an estimated $15 to $20 million.

With industry expansion, more emphasis continues to be placed on aquacultural economics. This research is leading to a better understanding and assessment of production and marketing costs. Economic and growth simulation models have resulted in the development of computer models for aquacultural producers. This software, coupled with other educational materials provided by the agricultural science and education system, has allowed existing and potential producers to assess risk more precisely, develop better farm management and marketing plans, and improve recordkeeping. By improving the ability of lending institutions to evaluate loan requests, Extension educational programs have assisted in making necessary development and operating capital available to aquacultural entrepreneurs.

Aquaculture Processing, Product Development, and Marketing: Processing and product development have progressed substantially. Production strategies have shifted for more year-round production and processing. Researchers and extension specialists have helped both large- and small-scale processors develop and manage facilities.

These programs resulted in an increased number of processing plants, decreased processing cost, and improved product quality and marketability. Processors, assisted by research and extension programs, responded to consumer demand for easy-to-use processed products by providing a variety of value-added products. The organization and development of producer-owned processing cooperatives also have greatly contributed to industry stability.

The marketability of aquacultural products has been enhanced as a result of improvements in processing and in product development. Research and extension programs have assisted small-scale producers in looking at alternative markets such as direct sales to retail outlets, small-scale processing, and sales to recreational users.

Science and education programs have helped prospective producers develop marketing plans and strategies, have educated consumers on the nutritional value and preparation of aquacultural products, and have contributed to product marketing. The aquaculture industry itself has made tremendous strides in developing marketing strategies and programs.

Progress in the aquaculture industry would not have been possible without adequate human resources. A substantial number of professional managers, researchers, extension specialists, and 4-H youth have been trained through resident instruction, graduate education and research, and extension educational programs within the agricultural science and education system.

The future looks promising. It appears likely that the U. S. aquaculture industry will expand along with increased consumer demand for fish and fish products. Aquaculture will remain a profitable alternative agricultural opportunity as long as production keeps pace with market development. Using the techniques of biotechnology, the industry should be able to increase production efficiency by developing species that are more readily adaptable to aquacultural production methods. If managed properly, these improved species will lead to greater profitability.

The U. S. aquaculture industry will face strong competition from foreign imports; however, high production efficiency and high-quality products will assure a strong competitive position for domestic aquaculture. The strong teaching, research, and extension programs already established, together with continued cooperation with industry, will continue to play an important role in future aquaculture development.

Advances in Forest Products Development*

In the last 10 years, cooperation among Government scientists, university faculty, extension specialists, and industry technologists has produced major advances in forest products. These accomplishments have contributed to meeting America's socioeconomic needs by helping extend the Nation's timber resource.

The progress has been achieved through introducing more material-efficient substitutes for wood products, extending the service life of products by protecting wood, and improving the efficiency of design and product-

*Material for this section was prepared by Henry Montrey, Forest Products Laboratory, Forest Service; and Thomas Maloney, Washington State University.

specification practices and production methods. In addition, research has discovered ways in which wood can be economically substituted for strategically important, nonwood materials. Solid technical data collection and objective, scientifically based analytical procedures in Government, university, and industry research and laboratory work underlie these advances.

Production Efficiency: There have been many improvements in production efficiency. Technical advances in wood processing have reduced the quantity of timber required to produce a unit volume of softwood and hardwood lumber or softwood plywood. Computer-based process-control equipment now enables sawmill and processing plant operators to maximize the amount of usable wood from logs. The heart of these systems is sophisticated mathematical models that accurately predict product recovery from a given log as a function of the log's key characteristics and its sawing breakdown pattern. Models such as the "Best Opening Face" (BOF) system for sawlog breakdown, developed by the Forest Service, have been integrated with computer scanning and sensing systems to produce these process-control technologies.

Lumber and plywood production efficiencies in the industry have also been boosted by technology transfer efforts such as the Forest Service's Sawmill Improvement and Veneer Improvement Programs. By adapting the BOF system and related computer models to produce technical information packages and mill-monitoring procedures, Forest Service and State Extension specialists have helped lumber and plywood manufacturers improve their timber-conversion efficiencies. Computer models currently being developed at the Forest Products Laboratory (FPL) will form the basis for better and bigger mill-improvement programs.

The Saw-Dry-Rip process, developed at the FPL, demonstrates improved lumber yields from young, fast-grown southern pine stands. This process can also produce structural lumber grades from plentiful, low-value hardwoods.

Numerous industry laboratories have expanded upon FPL research on paper press drying. Industry is attracted to this technology because it can reduce total raw material requirements and permits substituting lower quality raw materials in the production of some paper products.

A major breakthrough of the decade was the discovery by FPL scientists of lignin-degrading enzymes. These enzymes, called ligninases, have potential for enhancing profitable pulp processing by decreasing the use of harsh chemicals, reducing pollution, and saving energy.

New Forest Products: New products have also been introduced. Rapid expansion in production and use of nonveneered structural panels—waferboard and oriented strand board—is by far the most significant forest product innovation in the last decade. Introduced as a means of converting abundant and low-cost Canadian and Great Lakes States hardwoods into a plywood substitute, this

technology has since been applied almost nationwide. Waferboard and oriented strand board now account for nearly one-seventh of current U.S. industry production in structural panels.

Many organizations have played important roles in developing and transferring this major product/process technology, including Forest Service and university laboratories, forest-products producers, and manufacturers (many European) of equipment to make composite panels. Research continues on the feasibility of producing these products from as-yet-unutilized wood species and on adapting the key processing technologies to produce other product types, such as oriented strand lumber and shaped oriented strand building products.

The development of laminated veneer lumber (LVL) is an almost equally important product innovation. Researched extensively at the FPL, several industry laboratories, and at least two universities, LVL has since been introduced to the construction industry by several firms. It is a high-strength, high-uniformity product for a host of engineered structural uses. LVL has led to development of a generation of engineered components, such as I-beams, which are being substituted for solid or laminated wood products and, in many instances, for steel and concrete in building construction.

Research on several processing technologies has demonstrated, as with Saw-Dry-Rip, that wood products can be produced more efficiently from existing resources or from the low-grade, abundant timber formerly overlooked by processors. Some of these technologies, however, also show the capability of producing entirely new product types. One example is steam-through pressing, developed jointly by the FPL, a major forest products producer, and a manufacturer of equipment for making composite panels. Injecting saturated steam into a flake, particle, or fiber mat during pressing can produce panels much thicker and more uniform than those made using conventional hot platen pressing, and at greatly increased production rates.

Better Wood Structures Design: Improvements in wood structures design and construction technology have enhanced the application of wood products. Advances in the procedures used by structural engineers to design wood structures and specify the products to be used in them have led to improvements in material efficiency. New building construction and engineering technologies have demonstrated significant material savings. The FPL, numerous university experiment stations, and several wood products industry associations are leading the progress in this area.

A good example is the Truss-Framed System invented by Forest Service research engineers and transferred to segments of the construction industry through the coordinated efforts of State and Private Forestry and State Extension services. For a typical house, truss-framed construction uses only 30 to 40 percent as much wood as conventional framing.

The results of several decades of research have been published in "Finishing Wood Exteriors: Selection, Application, and Maintenance" (Agriculture Handbook number 647). Written through a cooperative effort between the FPL and Purdue University Extension Service, this compendium brings together a wealth of useful information in a form that communicates clearly to consumers. It joins a long list of successful forest-products-related Agriculture Handbooks ("Wood Handbook," "Dry Kiln Operator's Manual," "Wood-Frame House Construction") and other technology transfer documents (such as the four volumes of the Clark C. Heritage Memorial Series on Wood) originating from the FPL.

Product Substitution: Substitution of wood for nonwood materials is an area that has experienced significant advances. For decades, the lignin fraction of wood has been the target of research aimed at the production of useful industrial chemicals. Pulping operations leave unused approximately 20 million dry tons of lignin annually, a valuable resource with potential for being converted into end products. Recent research at Forest Service, university, and industry laboratories has increased greatly the number of end products that can be made from lignin. These include such important products as adhesives, phenolic compounds, toluene, and benzene.

The strategic dependence of the United States on petrochemical products and the countries that produce them can be lessened by devising ways to make alcohol and other fuels from wood. A major cooperative project between the FPL and the Tennessee Valley Authority has resulted in a pilot plant in Alabama that produces ethanol from hardwoods through hydrolysis.

Plant Germplasm Management*

*Material for this section was prepared by Henry Shands, ARS-USDA, Beltsville, MD; Richard Lower, University of Wisconsin, Madison; and the ARS Germplasm Matrix Team.

The National Plant Germplasm System (NPGS): The NPGS was formed to acquire, preserve, and distribute plant germplasm essential for developing and protecting this Nation's food and fiber crop productivity. More recently, evaluation and enhancement of germplasm have been added to NPGS activities.

Federal agencies, State universities, and private industry work together to ensure the success of NPGS. Federal agencies include the U.S. Department of Agriculture's Agricultural Research Service (ARS), Animal and Plant Health Inspection Service (APHIS), Cooperative State Research Service (CSRS), and Extension Service (ES). State universities and agricultural experiment stations contribute individually and collectively to the national efforts through regional activities. Private industry contributes by providing grant support; performing tasks such as regenerating and evaluating germplasm; contributing germplasm; and participating on advisory committees.

NPGS users include:

- plant scientists (primarily plant breeders in public and private institutions) who are developing new hybrids and varieties for American agriculture.

- research scientists who are studying the fundamentals of plant life, the complex interactions of hosts with pathogens and pests, the genetic traits involved in nutritional quality of foods, and the genetic traits essential to improved plant productivity.

Through long-range planning, NPGS has progressed from a fledgling system that concentrated on the acquisition and preservation of germplasm to a mature, user-driven system involving comprehensive evaluation, enhancement of unadapted germplasm, and an operational database management system.

The various NPGS elements have been linked into a coordinated national system. This has strengthened linkages with private seed companies and their plant breeders. Numerous national and international meetings, seminars, and working sessions have helped to promote understanding and cooperation in the area of plant genetic resources.

International Dimensions: The NPGS solidified its international dimension through its cooperation with the International Board for Plant Germplasm Resources. This cooperation involves plant acquisition, base collection backup, and interaction with the International Agricultural Research Centers in support of the NPGS objectives. Interactions with the National Plant Germplasm Committee and the National Plant Genetic Resources Board have enhanced both short- and long-term planning.

Thirty-six Crop Advisory Committees (CAC's) advise the NPGS management about important crop-specific needs. These interdisciplinary committees (breeders, geneticists, pathologists, entomologists, cytogeneticists) focus their

expertise on plant acquisition, preservation, evaluation, and enhancement. The committees are composed of scientists from both the private and public sectors.

Germplasm Databases and Germplasm Storage: A national plant germplasm database, Germplasm Resources Information Network (GRIN), operates from dedicated computers at the National Agricultural Library in Beltsville, Maryland. GRIN eventually will provide data on each of about 400,000 plant items catalogued in the national plant inventory. The information is available by computer to scientists involved in NPGS activities. With guidance from CAC's, crop descriptors for use in the database have been standardized. The CAC's also identified critical data to gather on the germplasm in the database.

Eight clonal germplasm repositories have been established to complement the previously existing seed repositories. Until these facilities were created, vegetatively propagated species had no formally identified collection and preservation sites. The repositories are located at Brownwood, Texas; Corvallis, Oregon; Davis, California; Geneva, New York; Hilo, Hawaii; Leesburg, Florida; Miami, Florida; Mayaguez, Puerto Rico; and Riverside, California.

Seed storage capacity at the National Seed Storage Laboratory (NSSL) at Fort Collins, Colorado, will be expanded to accommodate the increasing germplasm acquisitions which have resulted from a heightened awareness of the Nation's crop needs and vulnerability. Projections show that the present facility will be filled by 1989.

The NSSL was designated as the center for the study of cryopreservation of seeds and vegetative materials. A pilot project indicated that approximately two-thirds of the seed held in the gene bank might be safely stored in liquid nitrogen (-196 degrees Centigrade) for an indefinite period. The project included an examination of specific container needs for long-term safekeeping of individual species. Research continues on preservation physiology and chemistry for seed and vegetative materials.

Plant Exploration and Acquisition: There is an increasing emphasis on plant exploration and acquisition of plant germplasm. More than 99 percent of U.S. crop acreage is planted to crops not native to the United States. Gene banks contain an estimated 50 percent of the germplasm needed for conducting an adequate job of crop improvement in the future. CAC's are identifying needed crop explorations to a broad range of countries and environments. They also are paying particular attention to situations where there is potential for loss of germplasm as urban development, opening of lands, and changing farming practices threaten centers of genetic diversity.

A new magazine, "Diversity," communicates the germplasm activities of the NPGS both domestically and internationally. It is published by a not-for-profit organization and is supported by individual subscriptions, corporations, and public institutions.

Through this annual Accomplishments Report, institutions and agencies can present evidence of their progress in meeting the goals and priorities previously identified by the Joint Council on Food and Agricultural Sciences. The Joint Council Reports Staff works closely with the Joint Council to select from information provided by the regional councils and the national committees (Agricultural Research, Extension, and Higher Education). The committees and regional councils reviewed the approximately 700 submissions from the various institutions and agencies and conveyed a representative selection to the Joint Council. The Joint Council used a ranking procedure to select the 27 submissions that are incorporated in this Report.

The 27 current accomplishments, which cover a wide range of problems that have been or are being addressed by the food and agricultural science and education system, represent areas where there has been significant progress

during the past year. They illustrate a considerable degree of planned cooperation and coordination among the States, USDA agencies, and other components of the system.

Cooperative Activities

Cooperative activities are those which consist of some combination of States, agencies, institutions, businesses, and disciplines coming together to address problems that have impacts upon the food and agricultural science and education system.

Agricultural Chemicals, Water Quality, and Environmental Management: The USDA Extension Service's agricultural chemical-environmental management program provides agricultural chemical users with information on how to use such chemicals safely, wisely, effectively, and economically and educates nonfarm people on the benefits of these chemicals and the safe practices and precautions necessary when using them. Additional information on potential environmental impacts is also provided.

Primary areas receiving attention include pesticides and pest management, water quality, and low-input agriculture. Typical examples of cooperating State programs include one in North Carolina, where an estimated 2,000 farmers and 1,000 nonfarm pesticide users have been trained in sprayer application techniques. In Oregon, the Extension Service is helping work groups reduce seasonal and migratory workers' exposure to pesticides. An Extension toxicology program in Michigan has distributed information on the use and misuse of chemicals to more than 3,000 citizens.

Other efforts include maintaining and enhancing the quality of water through a clean water program, which now includes 21 projects in 22 States. In Pennsylvania, for example, funds from the Renewable Resources Extension Act, the Chesapeake Bay Program, and Rural Housing Improvement Program have been used to sponsor 14 county water quality clinics. Approximately half of the 1,200 participants have had their water tested; as a result, the quality of drinking water in participating counties has improved. In Vermont, farmers are taking more responsibility to reduce use of fertilizers and pesticides as a result of information developed by State Extension, Soil Conservation Service, and Economic Research Service personnel. Extension personnel in Wisconsin have helped to educate policy makers in 71 counties on water policy issues and controls.

Food and Nutrition Research and Education: The U. S. Department of Agriculture initiated a comprehensive national plan for food and nutrition research and education. Administered by the Department's subcommittee for human nutrition, it is designed to help coordinate the activities of 13 USDA agencies that administer programs pertaining to human nutrition matters.

The plan includes statements on the Department's mission, legislative authority, and nutrition policy, and it outlines specific agency roles. Also included are a description of the Department's programs, resources, and infrastructure that deal

with human nutrition research, consumer information and education, food assistance, and food inspection and marketing. Finally, the plan covers details about funding levels, coordination, and strategies for implementation. This national plan already has fostered coordination of the human nutrition research and education activities of the State Cooperative Extension Services, the State Agricultural Experiment Stations, and the private sector. It also has given consumers more nutrition choices in the marketplace by making sound nutrition information available to food manufacturers.

Promoting Agricultural Profitability: Over the past several years, the food and agricultural science and education system has played a key role in enhancing the potential for increased profitability by providing sound financial management information to farm and agribusiness managers. (See "Easing Financial Stress," p. 8.)

A national Extension Service forum in 1987 defined critical issues and goals to help producers: (1) understand the global environment in which they must compete; (2) analyze macroeconomic conditions (including domestic and foreign agricultural policies and programs) and trade policies; and (3) enhance management skills required to integrate production, financial, and marketing skills for maximum profits. An Arkansas program jointly funded by rice producers and Extension is speeding the latest research results to producers with the goal of enhancing farm management for maximum profit. Two years of data have shown that producer returns above costs have increased significantly.

Alternative agricultural opportunities are being identified as part of this long-term effort to promote a profitable U.S. agriculture that is competitive in the global economy. Many agricultural producers are developing alternatives to improve their incomes while remaining on the land. Oklahoma producers who have turned to producing cucurbits—watermelon, cantaloupe, squash, pumpkins, and cucumbers—report that these crops have generated over $9 million in annual farm income. In Louisiana, increased emphasis is being placed on the development of aquatic foods. For example, crawfish and catfish production have increased substantially in the last few years as alternatives to previous farming systems.

Electronic Dissemination of Agricultural Information: Four major programs are adapting emerging electronic and computer technologies to disseminate agricultural information. These pioneering efforts were either initiated or given renewed impetus by the National Agricultural Library (NAL) in cooperation with land-grant university libraries and information centers last year.

- Digitized text—More than 50 land-grant and other agriculture-related university libraries agreed to support and participate in a nationwide cooperative project with NAL to establish and evaluate a text digitizing image system for preserving and providing computer access to the contents of agricultural library materials.

- Full-text storage and retrieval—Fifteen institutions, most of which are land-grant universities, are participating in Phase II of the full-text storage and retrieval laser-disc project. The texts of 12 USDA and State Cooperative Extension Service publications are being placed on a second laser disc for this project.

- Interactive on-line course—The NAL worked with the University of Maryland to design, produce, and evaluate AGRICOLearn, an interactive course for instruction in the on-line searching of the AGRICOLA database.

- Photos on laser videodisc—The University of Maryland also cooperated with NAL in a pilot project to explore the effectiveness of laser videodisc technology as a storage medium for photo collections. This technology has the potential for integrating graphics with text in electronic typesetting and composition of published materials.

In addition, 39 land-grant universities are now acquiring, cataloging, indexing, and offering document delivery of Experiment Station and Extension Service publications. The NAL is also establishing and providing selective, indepth access to worldwide literature on a number of topics, and is actively exploring the development of computer-based expert systems that will help users obtain answers to questions on agricultural topics.

The Agricultural Research Service (ARS) is making its research results available to a wider audience. In October 1986, ARS began offering industry firms direct access to TEKTRAN, a computer database containing over 7,000 brief, easy-to-read summaries of the latest ARS research.

Scientific Expertise Development

Training Scientists To Meet National Needs: The National Needs Graduate Fellowships Program has readily proven to be the most successful initiative ever undertaken by the Department to assure the Nation of the scientific expertise base essential for world leadership in agriculture. The program was initiated in 1984 with 259 doctoral and 44 master's fellows. Institutional grants providing 3 years of support for the second class of 58 doctoral fellows were awarded by the USDA Office of Higher Education Programs in 1987. These newly recruited fellows will pursue degree specializations in biotechnology, food science, and human nutrition.

Through a new scholarship program involving private-public cooperation, RJR Nabisco, Inc. is helping land-grant universities attract brilliant young undergraduate scholars into the agricultural sciences. In 1988 RJR Nabisco will provide $640,000 and participating universities will provide $320,000. The first class of 20 scholarship winners will be selected in spring 1988 and will begin college in fall 1988.

The academic excellence of the outstanding young men and women who will be supported by these programs is such that they hold great promise for developing

into the types of intellectually productive scientists and professionals essential to revitalizing U.S. agriculture's scientific posture and its competitive edge in both domestic and world markets.

Curricular Innovations: Many colleges of agriculture, including those at Michigan State University, the University of Nebraska, and the Pennsylvania State University, are using a systems approach to more effectively develop students' data analysis and decision making capabilities.

At Michigan State, students enroll in a 15-credit program of courses that integrate instruction in computer science, animal science, horticulture, and resource development with such production operations as feeding livestock and using power machinery. Incorporating a systems approach to the planning, purchasing, managing, and marketing of cattle and lambs, students in the university's Learning Corporation have developed software programs for cost-effective feeding systems and quality control in animal performance factors.

After participating in a national workshop on a systems approach to teaching agriculture and natural resources, a team of faculty and administrators from the University of Nebraska redesigned courses within the College of Agriculture to integrate the systems concept. The Pennsylvania State University also designed new courses that incorporate a systems approach to learning. As a result, agriculture students take more writing-intensive and problem-solving courses and spend more time studying the interrelationships of ethical and societal issues in food, agriculture, and natural resources development.

Developing Agribusiness Leaders: A Conference on "Developing Tomorrow's Agribusiness Leaders" brought 180 key leaders together at the White House to discuss the role of education in restoring U.S. agriculture's worldwide competitiveness. U.S. Trade Representative Clayton Yeutter; Secretary of Agriculture Richard Lyng; and Alan Tracy, Special Assistant to the President for Agricultural Trade and Food Assistance, were among the featured speakers.

Participants included agribusiness executives, university presidents, agriculture school deans, business school deans, and Federal and State agriculture officials. They discussed the outlook for U.S. agribusiness, private-sector expectations of agribusiness graduates, the need to shift curriculum emphases from production agriculture to agrimarketing, and closer relationships between colleges of agriculture and business.

In the followup to the conference, USDA has provided support to the Lincoln Institute for Land Policy to conduct a national project through which schools of agriculture, schools of business, and the business community will develop agribusiness education programs to provide students with the depth and breadth of competencies essential in tomorrow's world.

Networking 4-H'ers Into Food and Agricultural Sciences: The Office of Higher Education Programs and Extension 4-H jointly initiated a national project that provides those youth participating in 4-H programs with greater exposure to career opportunities related to food and agricultural sciences. The goal is to interest more 4-H'ers in pursuing a higher education degree in food or agricultural sciences.

The program consists of three major emphases addressed through national model projects: expanding agricultural sciences in the 4-H curriculum; food and agricultural career education for targeted groups; and special programs through which 4-H high school seniors can carry out innovative scholarly projects and earn university academic credit.

These model projects are being developed by 4-H and resident instruction faculty at the University of Wyoming, the University of Florida, North Carolina State University, the University of Missouri, and the Pennsylvania State University.

Natural Resources

Degrading Pesticides With Soil Bacteria: Agricultural Research Service scientists are using soil bacteria to degrade chemical pesticides before they can reach ground water. Some pesticides have tight chemical bonds that prevent bacteria from breaking them down to nontoxic compounds. Ultraviolet light and oxygen "loosen" these bonds so that these soil microbes can work. A mobile ultraviolet light-generating unit to which 11 pesticides were exposed worked effectively and did not damage the microorganisms or alter soil pH.

The researchers then developed tougher "pesticide-eating" bacteria. One species tested, *Flavobacterium*, produces an enzyme that partially breaks down coumaphos, a chemical used in a dip to kill ticks on livestock. Unfortunately, this bacterium does not survive long enough in coumaphos waste waters to complete degradation of the chemical. The scientists have now isolated the gene responsible for enzyme degradation of coumaphos and have placed it into *Escherichia coli*, a bacterium often used in genetic engineering. The modified *E. coli* does produce the pesticide-degrading enzyme, but only 1/50 of the amount needed. The scientists are now increasing the gene's enzyme production, and will then put the gene into another stronger bacterium designed to survive cattle dip.

Reducing Erosion and Maintaining Water Quality by Controlling Runoff: North Carolina and Virginia agricultural experiment station scientists have studied the effect of heavy spring rains and other environmental factors which result in soil nutrient drainage and the transfer of sediments from agricultural lands into important estuary systems. Research has emphasized reducing runoff by changing cultivation practices and using grassways and other techniques to filter out sediments. This reduces the nitrogen and phosphorus content of runoff, thereby minimizing water quality degradation. These research efforts have resulted in erosion reduction, better water quality, protection of highly productive sources of shellfish and finfish, and better criteria upon which to judge the potential damage of drainage.

Providing Management Information to Woodland Owners: A major challenge to Extension forestry programs is to provide landowners with sufficient indepth information to manage their woodlands wisely. Many woodland owners live in cities and seldom see their woods. In order to convey these management information needs, Extension woodland-owner conferences have been held in major cities to reach absentee owners where they live and work.

In Minnesota, 250 woodland owners attended a meeting about forestry and wildlife. The Maine Extension Service, in cooperation with the Maine Public Broadcasting Network, developed a 13-part television series called "Great American Woodlots". This series profiled successful woodlot owners and discussed complex and sometimes controversial forest management issues. It also provided woodland owners with practical operational information for improving their forests. The series has been made available via satellite to public television stations, cable companies, and others throughout the United States, and has been viewed by millions of Americans.

Crop Production and Protection

Understanding Nutrient Function and Transport: Knowledge of how nutrients are transported in plants and how plant cells respond to various nutrients is of great importance in improving crop yields and the quality of plant products. Cornell University plant physiologists have isolated and purified a biological "pump" from plant roots that enables nutrients from the soil to be more readily taken up by plants. These pumps play a major role in moving minerals and other nutrients through roots, stems, and leaves and eventually into seeds and fruit. Further research can now be directed to finding how the plant coordinates nutrient movement. The soybean plant has been used as a model to study transport of sugars into the seeds. The amount of sugars in the developing seed affects quality and market value.

In another basic study, Washington State University scientists have accumulated evidence on the role of calcium in transmitting signals from three sources: light, gravity outside the cell, and hormones within the cell that affect plant growth and development. Understanding the calcium messenger system permits controlling the signal process so that plant growth and development can be manipulated. The potential impact on agricultural practices and biological advancements is enormous. Among the beneficiaries of this research are space biology programs which are already emphasizing the calcium messenger system to understand plant growth and development in outer space and to design life-support systems for future space stations.

Using Bacteria To Reduce Frost Damage to Plants: Plant frost injury is responsible for $3 billion in annual losses in the United States. California scientists have reduced frost damage to plants by eliminating frost-inducing or ice-nucleating bacteria. If these bacteria are replaced with a non-nucleating strain of the same bacteria, frost damage is reduced substantially. The change in the properties of the bacteria is accomplished by genetic engineering techniques. The genes responsible for ice-nucleation in two bacterial species have been cloned and

internal deletions have been made, thus changing the bacteria from "ice-plus" strains to "ice-minus" mutants.

Research Yields Better Fruits and Vegetables: Redesigned fruits and vegetables that look and taste better, contain more nutrition, and stay fresh longer are emerging from Agricultural Research Service efforts. Improved versions of familiar staples include a carrot that is vitamin packed (Beta III), a baking potato for the East that is drought resistant (Russett), and a mildew-resistant cantaloupe. These new fruits and vegetables are being developed to resist diseases, insects, and damage from cold; to breed more vitamins and minerals into the food itself; and to get the products to the table faster so consumers will have produce that is fresher, tastier, juicier, and easier to eat.

Other examples include strawberries and lettuce. An exceptional new high-yielding strawberry, Lester, is now available to the home gardener. The Lester variety has built-in resistance to root rot, ripens earlier, is more attractive, and has a skin less susceptible to shipping damage than other midseason varieties, making it more marketable. The Lester variety is also resistant to leaf diseases and fruit rots. While the variety is best adapted to the Mid-Atlantic area, it has been successfully grown from New England to North Carolina and from Maryland to Illinois.

A new iceberg lettuce variety that is resistant to big vein—a major disease of this crop—has been developed and given to seed companies. Named Pacific, the lettuce is suited for the Salinas and Imperial Valleys of California, where 40 percent of the Nation's lettuce crop is grown and where big vein is a significant problem to lettuce growers. Big vein causes an unattractive crisscrossing of white or pale yellow veins in lettuce leaves, and often prevents normal lettuce heads from forming or delays growth of the head.

Animal Production and Protection

Leaner Pork Produced With Growth Hormone: Health and dietary concerns and changing lifestyles of American consumers have led to a dramatic decline in red meat consumption. Adverse publicity about the impacts of high fat content of red meats has overshadowed many positive aspects, which include the fact that red meat has high nutritional values and is an excellent source of vitamins and minerals.

Animal scientists at Cornell University have made major research advances which will have a significant impact on animal production. Daily injections of the pig growth hormone, "porcine somatotropin" (pST), have made young pigs grow faster with dramatically leaner meat. The porcine growth hormone, when used in growing pigs, has profound beneficial effects on both feed efficiency and carcass composition.

Specifically, 100-pound pigs grow 15 to 18 percent faster than untreated animals, reaching market weight of 220 to 230 pounds 7 to 10 days quicker, with a 30-percent gain in feed efficiency. At the same time, the carcasses of the hormone-treated pigs have 55 percent less fat and 15 to 18 percent more muscle.

These results have important implications for both producers and consumers as more efficient methods to produce leaner meat become more and more critical in meeting changing consumer desires.

Assay Developed for Detecting Toxins in Feeds: Under certain conditions, toxins may be produced in animal feeds. These toxins can cause serious animal disease problems and may enter the human food supply. Michigan Agricultural Experiment Station researchers found that several toxins occasionally found in cereal grains can suppress the immune system and cause a 90 percent mortality rate in mice. The most serious problems are created when the mycotoxins are fed in combination.

The Michigan scientists also have developed an assay method for the mycotoxins vomitoxin and zearalenone using the monoclonal antibody technique. Antibodies have been used to detect these mycotoxins in grain at levels as low as 50 parts per billion using a simple 10-minute immunoassay. Such assays are of great value as quality control tools on the farm and as diagnostic indicators in veterinary laboratories.

Foreign Genes Transmitted to Offsprings: Agricultural Research Service scientists have inserted engineered material into newly laid chicken eggs and have shown that the genetic material is transmitted to the offspring of these chickens. When a harmless strain of avian leukosis virus was inserted into the germline of chicken embryos, the new chicken line transferred the virus to the offspring. The success of this technique depends on the use of a virus that spreads through the developing embryo and becomes incorporated within the reproductive cells. This work paves the way for introducing foreign genes that can carry messages for genetic resistance to disease, decreased fat production, increased egg production and fertility, and better feed efficiency.

Effective Ranch Management System Developed: Making livestock enterprises successful involves the coordination of several fields of knowledge into a workable system. The Texas Agricultural Extension Service has developed a widely used Total Ranch Management (TRM) program which integrates agricultural economics and livestock, range, and wildlife management into the management, utilization, and marketing of ranch resources. TRM serves as a model for programs in Kansas, Colorado, and Montana.

Over 200 Texas ranchers enrolled in an 8-day school where Extension specialists integrated various disciplines important to ranch management. Following the school, an interdisciplinary team visited each ranch to make recommendations. In addition, workshops involving Extension agents, Soil Conservation Service specialists, and Agricultural Stabilization and Conservation representatives trained in TRM helped ranchers apply the management concepts.

Processing, Marketing, and Distribution

New Species of Cellulose-Degrading Bacteria Isolated: Researchers at the University of California, Davis, have isolated a new species of *Clostridium* that is capable of breaking down rice straw, sawdust, and untreated cellulose. Cellulose is a complex carbohydrate found widely in nature; the enzyme which breaks it down is called cellulase. One of the genes in this new species which causes the production of cellulase has been cloned in *Escherichia coli* and plans are underway to clone the two other major cellulase genes.

The next step will be to place all three cellulase genes in one plasmid (a DNA molecule capable of autonomous replication in a bacterial cell) and to transfer this plasmid back into the original *Clostridium* strain or into another organism, such as *Bacillus subtilis*, to form a hypercellulase-producing strain. This strain will be used to degrade rice straw, sawdust, and other cellulose products to produce cellobiose, a simpler sugar from which useful products can be developed.

Cellulose degradation is the limiting step in converting complex carbohydrates to feeds that are usable by animals. The isolation of this microorganism is highly significant because it will permit byproducts such as straw or sawdust, which once posed serious solid waste management problems, to be converted to feeds. Additional benefits include such factors as decreasing air pollution from rice straw burning.

Improved Fermentation Process Developed: A system for high-rate fermentation, developed by the Illinois Agricultural Experiment Station, results in a greatly increased amount of production per unit of time. Use of this system, called the "Illinois Membrane Bioreactor," increases the rate of production of ethanol from lactose by 25 to 50 times. In addition to a dramatic reduction in equipment size and operating cost, this procedure allows better process control and reduces the amount of post-fermentation processing.

Successful fermentations using the Membrane Bioreactor include production of ethanol from glucose and from lactose and whey permeate, simultaneous hydrolysis and fermentation of lactose into ethanol, production of citric acid from sucrose and glucose, production of lactic acid from glucose and whey permeate, and production of 2,3-butylene glycol from lactose and from both sweet and acid whey. The growing importance of biomass-based technology in meeting future fuel and energy needs makes this newly developed fermentation process a significant breakthrough.

Better-Tasting Low-Lactose Milk Developed: Many people, especially those in less-developed nations, cannot drink milk because of an intolerance or allergic reaction to milk sugars, known as lactose. Scientists of the Mississippi Agricultural Experiment Station have developed a low-lactose milk using a new ultrafiltration process to filter out the lactose without affecting fat or protein. A major problem with previous forms of ultrafiltrated, low-lactose milks has been that the process imparts a flat and watery taste. Now, however, researchers are improving the flavor and nutritional quality by using other sugars to replace the lactose and by adjusting the fat and protein content.

Agricultural Policy Analysis

International Macroeconomics Influences: Economic Research Service economists have examined ways in which international macroeconomic events influence U.S. agriculture. Research focused on the evaluation of the effects of exchange rate changes on the competitive position of U.S. agriculture in overseas markets, the impacts of Third World debt on global agricultural markets, and the impacts of declining petroleum prices upon agricultural imports and exports.

Exchange rates were found to be a significant determinant of changes in U.S. agricultural trade and competitiveness. Research results indicate that adjustments to exchange rate changes generally take 3 years. In addition, exchange rates were found to be significantly more important than foreign economic activity in determining the level of U.S. agricultural exports. U.S. farm programs, such as loan rates and target prices, however, were twice as important as exchange rates.

Results of research on Third World debt indicate that the debt crisis is a far more serious constraint to the world economy than had been earlier estimated. Significant withdrawal of credit to the developing countries began in 1983 and accelerated in 1985 and 1986. Credit availability not only has implications for the ability of some developing countries to commercially export agricultural goods, but also has longer term implications for declines in gross domestic capital formation and future economic growth.

Other macroeconomic research efforts involved analyses of oil price declines on world and U.S. agricultural trade. One important finding is that, throughout the decade of the 1970's, the value of Soviet grain imports was nearly a constant proportion of their energy export earnings. That close relationship identified a potential constraint for Soviet ability to purchase agricultural products on the world market.

Agricultural and Trade Policies of Foreign Governments: The financial crisis that occurred as a result of declining foreign markets for U.S.-grown agricultural products gave rise to the need for better information on international policies and programs affecting agricultural markets. To meet that need, Economic Research Service economists developed a database on foreign government policy and program interventions in the production, consumption, and trade of agricultural products.

Information on a wide array of policies and programs has been compiled into a computer database. It contains detailed descriptions of agricultural trade barriers, producer price and income support programs, consumer price policies and subsidies, input subsidies, the operations of State trade and marketing boards, bilateral agreements, and export credit programs.

In a second phase of the policy project, measures of protection (producer and consumer subsidies) have been calculated. Producer and consumer subsidy equivalents have been estimated in major commodities and inputs for major industrialized countries and in a selected number of developing countries that are likely to be important in multilateral agricultural negotiations.

Comparisons of assistance levels to producers show that low protection is provided to U.S. producers of soybeans, pork, poultry, and beef but that U.S. producers of sugar, dairy products, wheat, and feed grains receive a high level of protection. In contrast, the European Community provides little protection for its corn producers, but high levels of protection are provided to its producers of sugar, beef, and dairy products. Japan provides a high level of protection to its barley, wheat, rice, milk, soybean, and beef producers. India's policies, which are common in some developing countries, involve taxing some commodities while subsidizing others.

Coordinating Farm Bill Conservation Information: Farmers across the Nation have become aware of the conservation provisions of the Food Security Act of 1985 (Farm Bill) through an interagency effort coordinated by the Cooperative Extension System. The total effort contributed significantly to the enrollment of over 18 million acres of highly erodible cropland in the 10-year Conservation Reserve Program within 15 months after the Act was signed. More than 1 million of these acres will be planted to trees—the largest tree-planting program in history.

In Tennessee, 530 agricultural professionals attended meetings to acquaint them with the provisions of the program. Extension trained county agents and prepared numerous publications and media releases. More than 2,000 farmers attended training sessions, and decision aid publications were distributed to more than 15,000. At that time, 71,000 acres of highly erodible cropland were shifted to the Conservation Reserve Program in exchange for over $3 million per year in payments to participating farmers. Georgia has the greatest proportion of conservation reserve lands going into trees; 93 percent of the State's 360,000 acre conservation reserve is designated for that purpose.

People and Communities

Human Nutrition: Scientists at USDA's Agricultural Research Service and State Agricultural Experiment Stations are gaining further insights into how human nutrition influences well-being. In the case of obesity, the Nation's number one nutrition problem, recent biotechnology developments have permitted the use of growth hormones to study the mechanisms of body fat reduction where obesity is of genetic origin.

In another study, a group of volunteers consumed a diet of 1,200 kilocalories of metabolizable energy without changing their exercise regimen. A second group consumed a diet of 1,800 kilocalories but increased their energy expenditure by 25 percent through controlled exercise. Volunteers in the exercise group were able to consume 50 percent more food and improve their fitness, yet achieve the same total fat loss as the group which restricted calories but did not exercise.

In other research, scientists have been able to identify a specific "Apo A-I" gene polymorphism associated with a high density lipoprotein deficiency. This genetic finding is of great significance since this marker should be useful in identifying those who have increased risk of coronary artery disease and in recommending appropriate treatments to decrease the risk-producing factors.

Another nutritional study found that 40 percent of elderly patients entering a hospital had little or no vitamin D in their blood. Deficiency of vitamin D leads to loss of calcium from the bones and may result in osteoporosis and bone fractures. Decreased milk consumption is the major cause of age-related vitamin D deficiency, followed by reduced exposure to the sun. Public awareness programs should help in remedying this dietary problem associated with the elderly.

Families Coping and Adapting to Stress: Stress upon farm and rural families resulting from the recent farm financial crisis has taken its toll on these families and their personal well-being. In response to these situations, studies and programs have been set up to help people cope more successfully with these adverse and trying conditions. This support is of great importance in helping people to deal with the changes and feelings that are associated with financial loss and the stress that is generated from such tragedies.

Scientists at Michigan State University's College of Agriculture and Natural Resources found that support groups and educational programs should focus on how to build family solidarity and adaptability and how to make changes in goals, rules, and roles to more realistically reflect the changing relationships brought about by financial crisis and stress. Such groups also help families to acquire the additional resources often needed to cope with major changes in life or occupation.

Scientists at California conducted the first long-term study of the roots of resiliency and sources of competence in a multiracial group of children who grew up in rural poverty. They concluded that sources of competence within the children and support within their families, as well as in their rural communities, enabled these youngsters to grow into competent, confident young adults who "worked well, loved well, and achieved well".

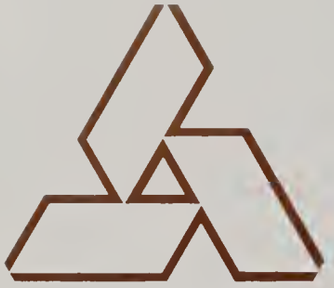
Another nationwide Extension Service educational program, which is built on an extensive research base and delivered in cooperation with other agencies, is targeted at strengthening American families. Parents report that affordable, high-quality child care and self-care of school-age children are their biggest problems. In 1986, as a result of Extension's efforts to address these problems, more than 1.2 million people in 25 States and 3 territories learned how to deal better with family relationships and develop coping skills. An additional 1.6 million people were reached through 150 mass media programs.

Extension Volunteer Leadership Expansion: Leadership development and training of volunteers is essential to maintaining this outstanding, resource-multiplying program. There are currently almost 3 million volunteers who provide services valued at $5.4 billion annually. An expansion of this program would result in significantly greater resources directed at solving rural family problems at minimal cost.

Considerable financial support for volunteer leadership development is provided by the private sector. Three States from each of four regions recently completed the first part of a three-phase project designed to: expand volunteer participation in middle management; increase volunteer representation on advisory councils, boards, and committees; and increase youth volunteerism. Funded by the W.K. Kellogg Foundation through the 4-H youth program with a 5-year, $2.7 million grant, the project will be expanded nationwide using training materials developed with the help of volunteers.

Through its Salute to Excellence Program, RJR Nabisco, Inc. provides an annual $1,000 grant to a volunteer leader from each State, enabling these leaders to travel to Washington, D.C., for public policy and leadership training. One direct result of this project is the recruitment of more than 5,000 new 4-H members and volunteers.

The Family Community Leadership Project, also funded by the W.K. Kellogg Foundation since 1982, is designed to help family members, especially women, to develop leadership and public policy skills. The Extension Master Volunteer Program, now operating in 36 States, is another example of Extension volunteer leadership development.



Accomplishments of the Joint Council, National Committees, and Regional Councils

Joint Council on Food and Agricultural Sciences

Fiscal Year 1989 National Priorities: The Joint Council, through its National Committees and Regional Councils, selected and ranked national priorities for research, extension, and higher education programs. State, regional, and national perspectives were taken into consideration during the selection process.

The Priorities Report first addressed three overriding societal concerns: competitiveness and profitability of the Nation's agricultural and agribusiness sectors; family economic strength; and revitalization of rural America. The eight specific food and agricultural science and education priorities selected were:

1. Maintain and Preserve Water Quality
2. Expand Biotechnology and its Applications
3. Develop and Maintain Scientific Knowledge and Expertise
4. Improve Understanding of Food, Diet, Human Nutrition, and Health Relationships
5. Sustain Soil Productivity
6. Assess New and Expanded Uses for Agricultural Products
7. Preserve Germplasm and Genetically Improve Plants
8. Improve Food Processing, Quality, Distribution, and Safety.

Major Activities: The Joint Council gave particular attention to several major issues and topics during the past year:

- Rural revitalization,
- Coordination and interaction with various agricultural groups.
- Cooperation among land-grant universities, institutions represented by the American Association of State Colleges and Universities, and the U.S. Department of Agriculture,
- Improving agriculture's image with young Americans,
- Application of meteorology in agricultural management,
- Germplasm and genetic diversity,
- An agenda for the agricultural engineering profession,
- Toward 2005—Northeast Agriculture, Food, and Forestry: Issues and Opportunities,
- Problem-solving through interdisciplinary activities.

Five-Year Plan Workshop: In January 1987, the Joint Council assessed its Five-Year Plan in a concentrated workshop that involved six "outside" reviewers representing industry, foundations, and academic administration. The purpose of the workshop was to ensure that the goals and objectives in the upcoming revision of the Five-Year Plan will be relevant to the issues and challenges that the food and agricultural science and education system will face in the next few years. The Five-Year Plan serves as an important foundation for the activities of the Joint Council and the food and agricultural sciences. Several teams of experts throughout the food and agricultural science system have prepared chapters for inclusion in the next Five-Year Plan, which will be published in March 1988.

Joint Council Brochure: A bifold brochure which describes the Council and its responsibilities was published in February 1987 and distributed nationally.

National Committees

National Committee on Agricultural Research: During the past year the National Committee on Agricultural Research continued its role of coordinating and encouraging joint research planning among its State and USDA member organizations. The 24 members of the Committee represent more than 140 State and Federal units engaged in agricultural research. Private agricultural research interests are represented on the Committee by the Agricultural Research Institute.

The Committee's primary consideration was how agricultural research can be most effectively employed to enhance farm and agribusiness profitability. The Committee developed a list of 23 high-priority programs that would relieve agriculture-related problems by creating new opportunities for farmers, ranchers, agribusinesses, and consumers. Many of these priorities are included in the fiscal year 1989 Joint Council Priorities Report.

National Higher Education Committee: The National Higher Education Committee has moved further toward its objectives of identifying major issues confronting higher education and encouraging efforts to address those issues. The Committee assigned top priority to "institution challenge grants" to stimulate and support university commitments and initiatives for curriculum improvements, enhanced and continuous faculty development, modernization of instructional equipment, and the expansion of undergraduate research opportunities. Another important priority was the establishment of a National Career Information System. The continuation of postdoctoral fellowship grants was also vigorously supported.

At one meeting of the Committee, which included representatives from USDA, the White House Office of Science and Technology Policy, and the U.S. Senate, participants addressed the need for a strategic plan for higher education in the food and agricultural sciences; the importance of enhancing the development of future scientific expertise in these sciences; and the need to change the perceptions of what agriculture entails, particularly with regard to new and pending technologies and the attraction of academically talented students.

The Committee arranged for experts from production agriculture, marketing, home economics, and veterinary medicine to make recommendations in the next year concerning curriculum updates. Other subjects being addressed are teacher recognition and assessing effectiveness of educational programs.

National Extension Committee: During the past year, the National Extension Committee addressed issues important to the Extension system, made recommendations, interacted with groups within and outside Extension, and developed information for use by the Joint Council. Two sessions were devoted to the needs of today's youth, particularly Extension's role in incorporating knowledge transfer into experiences through which youth can deal with current

problems and develop skills for the future. Another issue, declining world trade in agriculture, was considered in terms of how trade volume and competition for world markets affect U.S. producers.

The national initiatives being developed by the Extension System received major attention. The Committee reviewed progress in the formation of eight initiatives which are a major thrust in Extension's forward planning. These initiatives were used as a basis for identifying Extension priorities for fiscal year 1989.

The Committee made recommendations to Extension Service/USDA administrators and the Extension Committee on Organization and Policy (ECOP) concerning youth development and preparing Extension professionals for the future. The committee also voted to include a representative of the Association of Administrators of Home Economics in its membership.

The Committee received special reports on technology transfer within the science and education system, preparation for Extension's 75th Anniversary, and activities of the ECOP Futures Task Force.

The National Extension Committee continues to interact with the other Committees and Councils of the Joint Council and with outside groups represented by liaisons in its membership. The Committee provided information to the Joint Council for use in the Priorities Report, Accomplishments Report, and Five-Year Plan.

Regional Councils

Northeast Regional Council: The Northeast Regional Council concluded a comprehensive project that examines the future of the agriculture, food, and forestry sectors and then recommends steps to enhance the economic viability of these sectors. This effort, entitled *Project Toward 2005, Northeast Agriculture, Processing and Marketing, and Forestry: Issues and Opportunities,* is contained in five volumes:

- The Consolidated Report
- Task Force I Report: Data and Projections
- Task Force II Report: Part 1, Agriculture, Food Processing, Marketing and Distribution
- Task Force II Report: Part 2, Forestry
- Task Force III Report: Land-grant Colleges of Agriculture

As a followup to this massive effort that involved over 100 professionals throughout the Region, the Northeast Regional Council is conducting subject-specific Regional Forums to disseminate and further refine the action agendas by which the economic viability of agriculture, food processing and marketing, and forestry can be enhanced.

The Northeast Regional Council also developed a list of ranked priorities for research, education, and higher education programs that were considered by the Joint Council as it put together the fiscal year 1989 Priorities Report. The Council continues to investigate ways by which its deliberations can be more readily utilized by the Joint Council on Food and Agricultural Sciences as that body fulfills its congressionally mandated missions.

Western Regional Council: The Western Regional Council conducted a meeting to discuss and agree on fiscal year 1989 priorities for research, extension, and higher education programs. Based on input from the Western Agriculture Research Committee, the Western Extension Committee, and the Western Higher Education Committee, the council identified priority areas for future emphasis. The group also identified the unique characteristics of the West which have an impact on these priority areas. The highest priority was placed on protecting water quality and increasing the supply of water.

Council representatives participated in a Western Regional Forum in July 1988 with Western Colleges of Agriculture and CARET representatives to identify ways of increasing effectiveness of communication with internal and external publics.

Appendix A:

The U.S. Food and Agricultural Science and Education System

Cooperative State Institutions:

• Land-grant colleges or universities in each State, as authorized in 1862, plus 16 colleges of 1890 and Tuskegee University, have programs of higher education in the food and agricultural sciences.

• Fifty-eight State agricultural experiment stations (many with networks of substations), plus 17 schools of forestry, and certain schools of home economics and veterinary medicine conduct research programs partially supported by Federal formula funds. Research investment (all sources) was $1.4 billion in FY 1987 and involved approximately 7,600 scientist years (SY) of research effort.

• Cooperative Extension Services exist in all 50 States plus the District of Columbia and U.S. territories. With total funding at approximately $1.1 billion, Cooperative Extension programs involved about 15,000 professional staff years, plus almost 3,500 paraprofessional staff years and significant contributions by nearly 3 million volunteers trained and supervised by professional Extension staff.

USDA Research and Education Agencies:

• The Agricultural Research Service allocated nearly $500 million in FY 1987. Research is conducted at 125 locations in the United States and abroad involving over 2,642 SY's.

• Other USDA agencies have limited but direct research and education roles:
Office of International Cooperation and Development
Soil Conservation Service
Agricultural Marketing Service
Office of Transportation
Agricultural Cooperative Service
National Agricultural Statistics Service
Human Nutrition Information Service

• The Cooperative State Research Service is the agency of the USDA through which Federal research funding for the States is channelled and coordinated on behalf of the Department of Agriculture, in cooperation with all of the State and Territorial Agricultural Experiment Stations, Colleges of 1890 and Tuskegee University, forestry schools, colleges of veterinary medicine, and other cooperating institutions. The fiscal year 1987 funding level for CSRS was $379.5 million. This included $40.7 million for the Competitive Research Grants program, $68.6 million for facilities at the land-grant institutions, and $7.6 million for higher education programs.

• The National Agricultural Library, funded at $11.1 million in FY 1987, provides wide-ranging library and technical information services.

• The Economic Research Service, with funding of $45 million for FY 1987, accounts for about 414 SY's of economic and social science data collection, research, and analysis.

• The Forest Service research divisions, with about $129 million in funding (including $6.0 million in support of a Competitive Forestry Research Grants Program) in FY 1987, provided about 713 SY's of research in resource management and utilization and in resource protection efforts.

Other Colleges and Universities:

• Approximately 200 other State-supported colleges or universities, including 65 with baccalaureate degree programs, conduct programs of higher education, research, and outreach in the food and agricultural sciences.

Other Federal Agencies:

• At least 14 Federal departments, commissions, and independent agencies besides USDA conduct research and education programs closely related to agriculture and forestry or provide funds to support programs in the USDA-State system. These include:

Department of Health and Human Services, through National Institutes of Health
Department of the Interior
Department of State, through the Agency for International Development
Department of Commerce
National Science Foundation

Private Firms:

• Research and development (R&D) are performed by equipment, seed, fertilizer, and other input suppliers; processors of food and fiber; and specialized private R&D firms. A July 1985 survey published by the Agricultural Research Institute estimates private sector annual research expenditures of about $2.1 billion.

• Field personnel and information specialists employed by vendors of food and agricultural supplies, equipment, and services disseminate technical information to farmers and to processors and distributors of agricultural commodities. Consumer service departments of most major food processors develop and deliver a wide variety of nutritional and technical information to consumers. Agriculture-related publications, as well as radio and television, provide timely information which is widely used by those who engage in food and fiber production and processing and is of interest to many consumers as well.

Other Private Organizations:

• Foundations and similar organizations facilitate or channel funds to research and/or education for the public good.

• Associations formed by private firms conduct research and/or educational programs for their members.

• Professional organizations and societies publish scientific papers and provide forums where agricultural research knowledge is disseminated and discussed.

Appendix B:

Members of the Joint Council on Food and Agricultural Sciences

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Appendix C:

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